Patent Application Transmittal

(only for new nonprovisional applications under 37 C.F.R. 1.53(b))
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Date: ___June 21, 2000___
Attorney Docket No.: ___450117-02628___

ASSISTANT COMMISSIONER FOR PATENTS
Box Patent Application
Washington, D.C. 20231

Sir:

With reference to the filing in the United States Patent and Trademark Office
of an application for patent in the name(s) of:

Besma KRAIEM, Janos ENDERLEIN

entitled:
CALIBRATION PROCEDURE FOR WIRELESS NETWORKS WITH DIRECT MODE TRAFFIC

The following are enclosed:
__X__ Specification (10 pages)
__X__ __3__ Sheet(s) of Drawings
__X__ __18__ Claim(s) (including __3__ independent claim(s))
_____ This application contains a multiple dependent claim

__X__ Our check for __$ 690.00__, calculated on the basis of the claims as
amended by any enclosed preliminary amendment as follows:

Basic Fee, $690.00 ($345.00) . . . . $ 690.00
Number of Claims in excess of 20 at $18.00 ($9.00) each: . . . . . -0-
Number of Independent Claims in excess of 3 at $78.00 ($39.00) each: . -0-
Multiple Dependent Claim Fee at $260.00 ($130.00) . . . . -0-
Total Filing Fee . . . . $ 690.00
_____ Assignment Recording Fee $40.00 . . . . -0-

__X__ Oath or Declaration and Power of Attorney
__X__ New _____ signed __X__ unsigned
_____ Copy from a prior application (37 C.F.R. 1.63(d))

_____ Certified copy of each of the following application(s) to substantiate
the claim(s) for priority made in the Declaration:

Application No.   Filed   In

Please charge any additional fees required for the filing of this
application or credit any overpayment to Deposit Account No. 50-0320.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP
Attorneys for Applicants

By _____
William S. Frommer
Reg. No. 25,506

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June 21, 2000

Assistant Commissioner for Patents
Washington, D.C. 20231

Re: U.S. Patent Application
      Applicants: Besma KRAIEM, Janos ENDERLEIN
      Our Ref.: 450117-02628

Dear Sir:

Enclosed are papers constituting the above patent application which is being filed under 37 C.F.R. 1.53 without a signed Declaration. Please accord a filing date and a serial number to such application and inform the undersigned thereof so that a signed Declaration and the surcharge required by 37 C.F.R. 1.16(e) may be duly filed.

Please address all correspondence to:

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> 745 Fifth Avenue
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Respectfully,

William S. Frommer
Reg. No. 25,506
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Enclosures

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Besma KRAIEM et al.

Filed : Herewith

For : CALIBRATION PROCEDURE FOR WIRELESS NETWORKS WITH
DIRECT MODE TRAFFIC

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PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Before the issuance of the first Official Action,

please amend the above-identified application as follows:

IN THE CLAIMS:

Please amend the claims as follows:

Claim 3, line 1, delete "or 2";

Claim 4, line 1, delete "anyone of the preceding

claims" and insert --claim 1--;

Claim 5, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 6, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 7, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 8, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 9, line 1, delete "anyone of claims 1 to 7" and insert --claim 1--;

Claim 10, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 11, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 12, line 1, delete "anyone of the preceding claims" and insert --claim 1--;

Claim 15, line 1, delete "or 14";

Claim 17, line 1, delete "anyone of claims 13 to 16" and insert --claim 13--;

Cancel claim 19.

REMARKS

The claims have been amended to eliminate multiple dependencies. The filing fee has been calculated based upon these amendments to the claims.

Respectfully submitted,

FROMMER LAWRENCE & HAUG LLP
Attorneys for Applicants

By William S. Frommer
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION FOR LETTERS PATENT

TITLE: CALIBRATION PROCEDURE FOR WIRELESS
NETWORKS WITH DIRECT MODE TRAFFIC

INVENTORS: Besma KRAIEM, Janos ENDERLEIN

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Description

1   The present invention relates to the calibration procedure for wireless net-
works with direct mode traffic, and in particular to the creation of a topology
map indicating the quality of connectivity of each wireless device of a wireless
network with all other wireless devices in said wireless network.

5

A typical wireless network, such as the IEEE 1394 based HIPERLAN type 2
broadband radio access network which specification is developed by ETSI is
shown in Fig. 3. An access point or central controller 15 has an up- and down-
link communication with several mobile terminals 11, 12, 13, and 14 and the

10   mobile terminals can also have a direct communication in-between each other
so that apart from the granting of resources for peer mobile terminals, e. g. the
first mobile terminal 11 and the second mobile terminal 12, the access point or
central controller 15 is not involved in the communication. Such direct com-
munications in-between two or more mobile terminals are called direct mode.

15   An IEEE 1394 bus with connected network devices is exemplary shown only for
the fourth mobile terminal 14.

The problem in wireless networks including direct mode traffic is that the
mobile terminals do not know with which other devices they have radio link.

20   Thus, they intend to request the central controller 15 to set up certain connec-
tions even though they are not possible. A second problem is the transmit
power control during direct mode traffic. Without knowledge about the radio
link quality always maximum transmit power levels have to be used until
appropriate levels are identified.

25

Therefore, a topology map has been introduced indicating the quality of con-
nectivity of each network device of a wireless network with all other network
devices in said wireless network. After distribution of this topology map, a
mobile terminal can check whether a connection is possible or not before

30   requesting it with the central controller. Furtheron, transmit power control
can be performed using an initial power level determined on the quality of con-
nectivity of the particular radio link.

Also, in case the topology map of the wireless network is not distributed in the
whole network, but only stored within the central controller enables the cen-

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1 tral controller to accept or reject connection requests between two wireless devices depending on the radio link quality. Furthermore. once the topology map has been created. the central controller can inform the peer wireless devices to set up their transmit power levels accordingly until accurate transmit power
5 control is performed.

Therefore. it is the object of the present invention to provide a method to create a topology map indicating the quality of connectivity of each network device of a wireless network with all other network devices in said wireless
10 network. Furtheron. it is the object of the present invention to provide network devices that are adapted to work according to the inventive method.

These objects are solved by the inventive method to create a topology map according to independent claim 1 and network devices for a wireless network
15 according to independent claims 13 and 18. Preferred embodiments thereof are respectively defined in the respective dependent claims.

A method to create a topology map indicating the quality of connectivity of each network device of a wireless network with all other network devices in
20 said wireless network according to the present invention comprises the following steps: performing a measurement phase in which a calibration signal is successively broadcasted by each network device and in which all respective other network devices receiving said calibration signal measure the received signal quality: performing a reporting phase in which the measurement results
25 are transmitted from each network device to the network device creating said topology map: and performing a creating phase in which said topology map of the network is created within the network device creating said topology map on basis of all received measurement results.

30 Therefore. according to the present invention a very quick creation of the topology map is possible. since no bandwidth is wasted transmitting small amounts of data. namely single measurement results. from the network devices that have measured the received signal quality of one control signal to the network device creating said topology map. but since first all measurement
35 results are collected before they are transmitted to the network device creating the topology map.

1 Preferably said measurement phase and/or said reporting phase are initiated by the network device creating the topology map.

Further, preferably the topology map is updated when a new network device
5 joins the network and/or after a predetermined amount of time has lapsed.

A first type of network device for a wireless network according to the present invention is characterized by means to broadcast a calibration signal, to measure a power level of a received calibration signal, and to transmit its measure-
10 ment results to another network device or to store it internally.

Preferably these functions are carried out on demand of another network device, but they can also be carried out on an internal demand. Therefore, the network device according to the present invention preferably comprises a
15 decoder that initiates the broadcast of a control signal and the measurement of the reception quality of one or more incoming broadcast signals upon reception of a measurement control signal and that further preferably initiates the transmission of one or more measurement results upon reception of a reporting control signal.
20

Preferably the network device according to the present invention is characterized by a report encoder that receives one or more signal quality indication signals and encodes therefrom a signal quality control signal to be transmitted to said other network device or to be stored internally.
25

A second type of network device according to the present invention is characterized by means to initiate a measurement phase, to initiate a reporting phase, and to perform a creation of a topology map on basis of measurement results received during the reporting phase.
30

This second type of network device preferably includes all features of the first type of network device according to the present invention.

The first type of network device according to the present invention is either a
35 mobile terminal or a mobile terminal having the functionality of a central controller, whereas the second type of network device according to the present invention always has the functionality of a central controller.

1   The present invention and its numerous embodiments will be better under-
stood on basis of the following exemplary description thereof taken in conjunc-
tion with the accompanying drawings, in which

5   **Fig. 1**   shows a network device according to the present invention;

    Fig. 2   shows the messaging in-between the central controller and two
                 mobile terminals during the calibration procedure to create the
                 topology map; and

    Fig. 3   shows an exemplary wireless network.

10

The mobile terminal shown in Fig. 1 is adapted to perform a direct mode cali-
bration according to the present invention. The shown mobile terminal has one
antenna 1 which is connected to the movable terminal of a transmit/receive
selection switch 2 which fixed terminals are respectively connected to the

15   transmitter and receiver signal path of the mobile terminal. In the receiver sig-
nal path a receiver 3 is directly connected to the respective fixed terminal of
the transmit/receive selection switch 2. This receiver 3 produces a data and
control signal input to a controller 6 and also outputs a signal wherefrom a
signal quality measurement unit 5 can determine the received signal strength

20   which is output to the controller 6. For the transmitter signal path the control-
ler 6 outputs a data and control signal to a transmitter 4 which modulates,
up-converts and amplifies this signal to a given signal strength which is indi-
cated to the transmitter 4 by a control signal generated by the controller 6 and
outputs the generated transmission signal to the respective fixed terminal of

25   the transmit/receive selection switch 2. Bi-directionally connected to the con-
troller are a user interface 7 and a memory 8. Furtheron, the controller 6 is
connected to a direct mode calibration decoder 9 and a direct mode report en-
coder 10.

30   The direct mode calibration decoder 9 receives the control signals generated by
the receiver 3 via the controller 6 and initiates the broadcast of a calibration
signal and the measurement of the reception quality of one or more incoming
broadcasted calibration signals from other mobile terminals upon reception of
a measurement control signal which is transmitted from the central controller

35   15. Furtheron, upon reception of a reporting control signal which is also trans-
mitted from the central controller 15 the direct mode calibration decoder 9 ini-
tiates the transmission of one or more measurement results to said central

1   controller 15. Therefore, all measurement results stored within the memory 8
    are communicated to the direct mode report encoder 10 by the controller 6 and
    said direct mode report encoder 10 generates a signal quality control signal
    that is transmitted via the controller 6 and the transmitter 4 to the central
5   controller 15. The central controller 15 creates a topology map on basis of all
    measurement results received from all mobile terminals during the reporting
    phase.

    In the following the calibration procedure will be described in connection with
10 Fig. 2 which shows the messaging in-between the central controller 15 having
    a medium access control identifier, i. e. MAC-ID3, and a first mobile terminal
    11 having a MAC-ID1 and a second mobile terminal 12 having a MAC-ID2,
    after the calibration procedure is decided to be started, since either a new mo-
    bile terminal joins the network or a timer has expired.

15

    In a first step S1 the central controller 15 send measurement control signals
    to both mobile terminals 11 and 12. Of course, the central controller 15 itself
    knows that the measurement phase of the calibration procedure will be per-
    formed. Therefore, after the first step S1 all three network devices, namely the
20 central controller 15 and the first and second mobile terminals 11 and 12, are
    initialized to perform the measurement phase. During the measurement phase
    all network devices within the wireless network successively broadcast a cali-
    bration signal and receive the calibration signals transmitted by the other net-
    work devices to determine their respective signal quality. Therefore, in a step
25 S2 the first mobile terminal 11 broadcasts its calibration signal to the central
    controller 15 and the second mobile terminal 12 which receive said calibration
    signal, measure its signal quality, and store it in an internal memory.

    Thereafter, the central controller 15 itself performs the broadcast of a calibra-
30 tion signal to the first and second mobile terminals 11 and 12 in a step S3.
    Both mobile terminals 11 and 12 respectively receive the calibration signal,
    measure its signal quality and store this value in an internal memory. Follow-
    ing in a step S4 the second mobile terminal 12 also broadcasts a calibration
    signal to the first mobile terminal 11 and the central controller 15 which
35 respectively receive this calibration signal, measure its signal quality and store
    this measured value in an internal memory. After all mobile terminals have
    broadcasted their calibration signals and these calibration signals are received

1   and measured by all respective other devices, the central controller 15 trans-
     mits a reporting control signal in a step S5 to the first mobile terminal 11 and
     the second mobile terminal 12. After reception of the reporting control signal,
     both mobile terminals generate a signal quality control signal comprising one
5   or more measurement results and transmit it respectively to the central con-
     troller 15. The first mobile terminal 11 transmits its signal quality control sig-
     nal in a step S6 to the central controller 15 and the second mobile terminal 12
     transmits its signal quality control signal to the central controller 15 in a step
     S7.
10

     Of course, the central controller 15 knows its own measurement results, since
     they are already stored in its internal memory. Upon reception of all measure-
     ment results from all other mobile terminals within the network, the central
     controller 15 generates the topology map which indicates the reception quality
15   for every radio link available within the network.

     To summarize the above procedure it can be said that the calibration proce-
     dure mainly consists of two phases, namely the measurement phase and the
     reporting phase. In an exemplary embodiment of an IEEE 1394 based HIPER-
20   LAN type 2 network during the measurement phase the calibration slot is
     transmitted using a dedicated control channel. It contains the source identi-
     fier. The calibration slot is transmitted using the maximum allowed transmit
     power level in order to avoid artificial hidden nodes. Each other wireless device
     measures the received quality, e. g. by means of the received signal strength
25   and stores it in an internal memory. During the reporting phase each wireless
     device reports its measurement results to the central controller using a dedi-
     cated control channel. The report slot contains the identifier of the wireless
     device and the report measurements. One or more measurement results can be
     transmitted in one report slot.
30

     Once all wireless devices have reported their measurement results to the cen-
     tral controller, the central controller (in a third phase) creates a topology map
     of the network which indicates the quality of connectivity of each wireless
     device with all others. A possible topology map of a network with n active devis
35   represented into a matrix is shown below:

1

	MAC-ID1	MAC-ID2	MAC-ID3	...	...	...	MAC-IDn
MAC-ID1		RSS 1-2	RSS 1-3	...	...	...	RSS 1-n
MAC-ID2	RSS 2-1		RSS 2-3	...	...	...	RSS 2-n
MAC-ID3	RSS 3-1			...	...	...	RSS31-n
...	...	...	...		...	...	...
...	...	...	...	...		...	...
...	...	...	...	...	...		...
MAC-IDn	RSS n-1	RSS n-2	RSS n-3	...	...	...	

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RSS n-m represents the received signal strength at mobile terminal n when transmitted by mobile terminal m. The central controller is also regarded as mobile terminal, since in a wireless network environment with mobile termi-nals the task of the central controller might be switched from one mobile ter-minal to another. According to the example shown hereinafter 4 bits are used to map the received signal quality, i. e. the received power to a signal strength code. Therefore, there exist sixteen possibilities of designated received power levels to be included in the topology map. According to the shown example, a bandwidth of < –90 dBm to > –30dBm is set with a step size of 3 dB and a range of –69 dBm to –48 dBm as a medium range mapped to one coding value.

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RSS2	Received Power at ARP [dBm]	Step Size
0000	< –90 dBm (no radio link)	
0001	–90	3 dB
0010	–87	
0011	–84	
0100	–81	
0101	–78	
0110	–75	
0111	–72	
1000	–69 ... –48	21 dB
1001	–45	3 dB
1010	–42	
1011	–39	
1100	–36	
1101	–33	
1110	–30	
1111	> –30 dBm	

Of course, any other mapping e. g. in a strictly linear or non-linear fashion can be performed as well.

An update of the topology map is always triggered by the central controller. It is started as a high priority calibration when a new mobile terminal joins the network so that an updated topology map is nearly immediately created, e. g. within 2 ms. Furtheron, a low priority calibration is started every time when a timer expires, e. g. every 100 ms. Low priority in this sense means that the calibration is carried out every time free resources are available.

The topology map of the network might be broadcast by the central controller to all mobile terminals and depending on the used system it might be trans- mitted as a whole or line by line. A mobile terminal receiving the topology map preferably stores this topology map together with a time stamp. Another possi- bility to give knowledge about the network topology to a mobile terminal is to

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1 just transmit a particular line or value of the topology map to the correspond-
ing network device.

Of course, the present invention is not only to be used with an IEEE 1394
5 based HIPERLAN type 2 network, but with any wireless network, preferably
with such supporting direct mode.

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Claims

1   1.   Method to create a topology map indicating the quality of connectivity of each network device of a wireless network with all other network devices in said wireless network, **characterized by** the following steps:

- performing a measurement phase in which a calibration signal is suc-
5   cessively broadcasted by each network device and in which all respective other network devices receiving said calibration signal measure the received signal quality;

- performing a reporting phase in which the measurement results are transmitted from each network device to the network device creating said
10   topology map; and

- performing a creating phase in which said topology map of the network is created within the network device creating said topology map on basis of all received measurement results.

15   2.   Method according to claim 1, **characterized in** that said calibration signal is transmitted in a dedicated control channel.

3.   Method according to claim 1 or 2, **characterized in** that said measurement results are reported in a respective dedicated control channel.

20

4.   Method according to anyone of the preceding claims, **characterized in** that said calibration signal is transmitted with the maximum allowed transmit power level.

25   5.   Method according to anyone of the preceding claims, **characterized in** that said topology map is updated when a new network device joins the network.

6.   Method according to anyone of the preceding claims, **characterized in**
30   that said topology map is updated after a predetermined amount of time.

7.   Method according to anyone of the preceding claims, **characterized in** that said topology map is stored in the central controller.

1   **8.** Method according to anyone of the preceding claims, **characterized in** that said topology map is broadcasted in the whole network.

9. Method according to anyone of claims 1 to 7, **characterized in** that only
5   the parts of the topology map related to a specific network device are transmitted to said specific network device.

10. Method according to anyone of the preceding claims, **characterized in** that said calibration signal is transmitted using an omni-directional antenna.
10

11. Method according to anyone of the preceding claims, **characterized in** that the contents of the topology map are codes that are mapped to receive power values.

15   **12.** Method according to anyone of the preceding claims, **characterized in** that said measurement phase and/or reporting phase is initiated by the network device creating said topology map.

13. Network device for a wireless network, **characterized by** means to
20   broadcast a calibration signal, to measure a power level of a received calibration signal, and to transmit its measurement results to another network device or to store it internally.

14. Network device according to claim 13, **characterized in** that said func-
25   tions are performed on demand of another network device or on an internal demand.

15. Network device according to claim 13 or 14, **characterized by** a calibration decoder (9) that initiates the broadcast of a calibration signal and the
30   measurement of the reception quality of one or more incoming calibration signals upon reception of a measurement control signal.

16. Network device according to claim 15, **characterized in** that said calibration decoder (9) initiates the transmission of one or more measurement re-
35   sults upon reception of a reporting control signal.

1 **17.**   Network device according to anyone of claims 13 to 16, **characterized by** a report encoder (10) that receives one or more signal quality indication signals and encodes therefrom a signal quality control signal to be transmitted to said other network device.

5

18.   Network device for a wireless network, **characterized by** means to initiate a measurement phase, to initiate a reporting phase and to perform a creation of a topology map on basis of measurement results received during the reporting phase.

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19.   Network device according to claim 18 including the features of anyone of claims 16 to 20.

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Abstract

Calibration Procedure for Wireless Networks
with Direct Mode Traffic

A calibration procedure of wireless networks to create a topology map mainly consists of two phases: a measurement phase during which each wireless device, i. e. all mobile terminals end the central controller, transmits a calibration signal in broadcast mode (S2, S3, S4) and each other wireless device measures the received signal quality and the reporting phase during which each mobile terminal reports the measured results to the central controller of the network (S6, S7). Both of these phases are preferably initiated by the central controller, the measurement phase with the broadcast of a measurement control signal to all mobile terminals (S1) and the reporting phase with the broadcast of a reporting control signal to all mobile terminals (S5). Based on all measurement results the central controller creates a topology map of the network once all reports have been received. This topology map is updated in two cases, namely when a new device joins the network with a high priority calibration and when a timer expires with a low priority calibration, i. e. only when there are enough free resources.
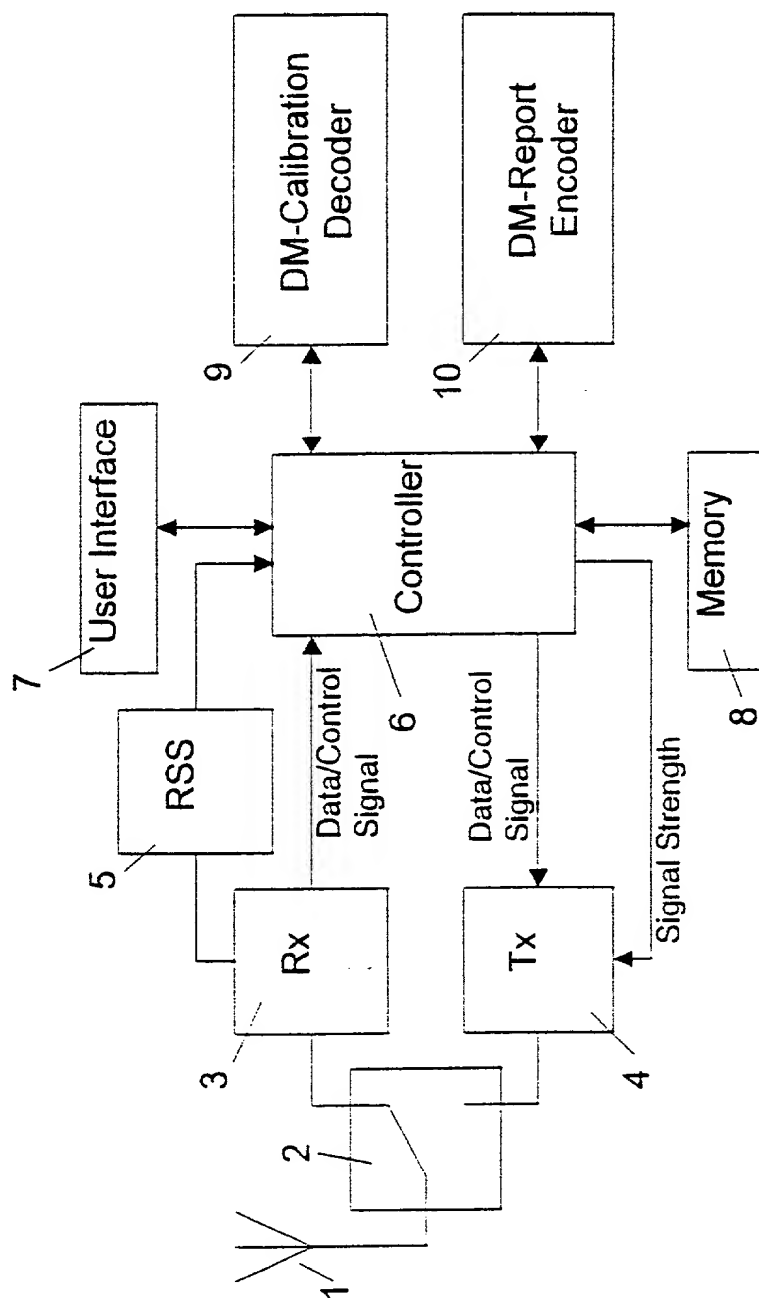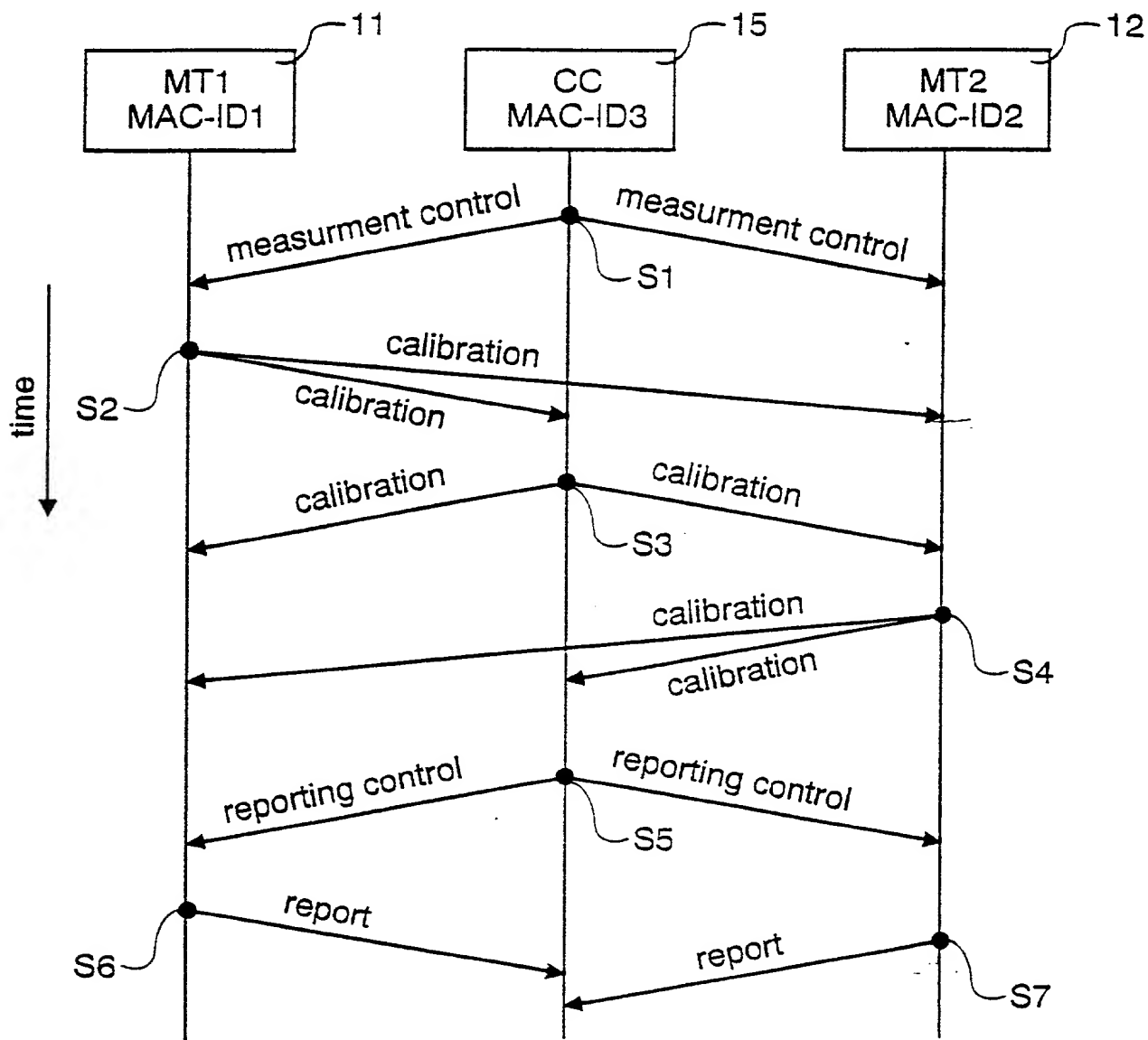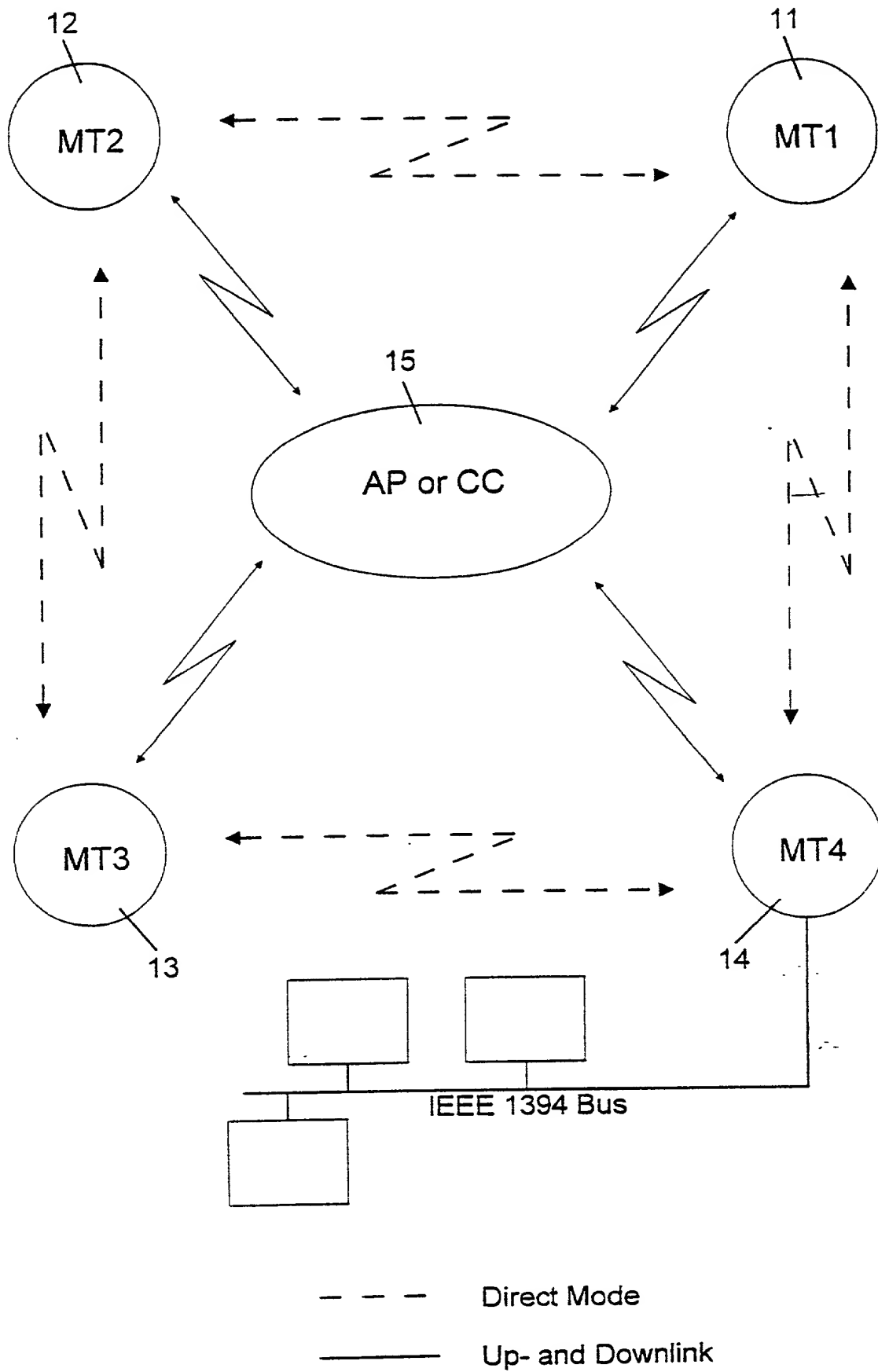
(Fig. 2)

Fig. 1

Fig. 2

Fig. 3

DECLARATION FOR PATENT APPLICATION (JOINT OR SOLE)
(Under 37 CFR § 1.63; with Power of Attorney)
FROMMER LAWRENCE & HAUG LLP

FLH File No. 450117-02628

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name,
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention ENTITLED:

CALIBRATION PROCEDURE FOR WIRELESS NETWORKS WITH DIRECT MODE TRAFFIC

the specification of which

   X   is attached hereto.

_____ was filed on _____ as Application Serial No. _____,

with amendment(s) through _____ (if applicable, give dates).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.
I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56.
I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)   [list additional applications on separate page]:   Priority Claimed:

Number:	Country:	Filed (Day/Month/Year):	Yes	No
99 112 129.4	Europe	23 June 1999	X	

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Sec. 1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S. Application(s) [list additional applications on separate page]:

Appln. Ser. Number: Filed (Day/Month/Year):   Status (patented, pending, abandoned):

I hereby appoint WILLIAM S. FROMMER , Registration No. 25,506 , and DENNIS M. SMID , Registration No. 34,930 or their duly appointed associate, my attorneys, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to file continuation and divisional applications thereof, to receive the Patent, and to transact all business in the Patent and Trademark Office and in the Courts in connection therewith, and specify that all communications about the application are to be directed to the following correspondence address:

WILLIAM S. FROMMER , Esq.
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Direct all telephone calls to:
(212) 588-0800
to the attention of:
WILLIAM S. FROMMER

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Note: In order to qualify for reduced fees available to Small Entities, each inventor and any other individual or entity having rights to the invention must also sign an appropriate separate "Verified Statement (Declaration) Claiming [or Supporting a Claim by Another for] Small Entity Status" form [e.g. for Independent Inventor, Small Business Concern, Nonprofit Organization, individual Non-Inventor].

Note: A post office address must be provided for each inventor.